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Summer Steelhead Creel Surveys on the Grande Ronde,
Wallowa, and Imnaha Rivers for the 1993-94 Run Year

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Grande Ronde, Wallowa, and Imnaha
Rivers for the 1993-94 Run Year

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SUMMARY

Objectives

1. Estimate angler effort in hours and days for summer steelhead fisheries in the Grande Ronde and Imnaha basins.
2. Estimate total catch, catch rate, and number of fish harvested in summer steelhead fisheries in the Grande Ronde and Imnaha basins.
3. Estimate the percent of hatchery summer steelhead in the total catch.
4. Determine length frequency, age composition, and sex composition of the fish that were caught.
5. Estimate, by tag code, the number of adipose-left ventral clipped plus coded-wire-tagged summer steelhead harvested.
6. Determine residence of anglers in summer steelhead fisheries in the Grande Ronde and Imnaha basins.
7. Compare historic estimates to 1993-94 run year estimates of catch rate, harvest, and angler effort for summer steelhead fisheries on the Grande Ronde, Wallowa, and Imnaha rivers individually.
8. Compare historic estimates to current estimates of catch rate, harvest, and angler effort for summer steelhead fisheries on the Grande Ronde, Wallowa, and Imnaha rivers combined.
9. Compare historic to current harvest during the fall and spring for summer steelhead fisheries on the Grande Ronde, Wallowa, and Imnaha rivers combined.
10. Compare historic to current punch card harvest and creel survey harvest for summer steelhead fisheries on the Grande Ronde, Wallowa, and Imnaha rivers individually.

Accomplishments and Findings

On the lower Grande Ronde River, we estimated that 2,607 anglers fished for 12,883 hours from 1 September through 31 December 1993 and 1 February through 15 April 1994. They caught and released an estimated 483 wild and 84 hatchery steelhead and kept an estimated 168 hatchery steelhead. Angler catch rate index averaged 18 hours per fish. The percent of the steelhead caught that were hatchery fish ranged from 11% in March 1994 to 67% in April 1994. Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead was 583 mm (± 286) for 1-ocean fish and 700 mm (± 18) for 2-ocean fish. Age composition of harvested hatchery steelhead was 11% 1-ocean fish and 89% 2-ocean fish while the sex composition was 24% male and 76% female. On the lower Grande Ronde River, 31 AdLV+CWT steelhead were harvested from our hatchery releases. Sixty-three percent of the anglers were from Union or

Wallowa counties, 25% were from other Oregon counties and 12% were non-residents.

On the upper Grande Ronde River, we estimated that 1,172 anglers fished for 3,230 hours from 16 February through 15 April 1994. They caught and released an estimated 59 wild and 18 hatchery steelhead and kept an estimated 26 hatchery steelhead. Angler catch rate index averaged 31 hours per fish. The percent of the steelhead caught that were hatchery fish ranged from 17% in March to 70% in April. Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead was 585 mm for a 1-ocean fish and 688 mm (± 56) for 2-ocean fish. Age composition of harvested hatchery steelhead was 25% 1-ocean fish and 75% 2-ocean fish while the sex composition was 25% male and 75% female. On the upper Grande Ronde River, no AdLV+CWT steelhead were harvested from our hatchery releases. Ninety-three percent of the anglers were from Union or Wallowa counties, 5% were from other Oregon counties and 2% were non-residents.

On the lower Wallowa River at Rondowa, we estimated that 426 anglers fished for 2,782 hours from 16 March through 15 April 1994. They caught and released an estimated 47 wild and 38 hatchery steelhead and kept an estimated 143 hatchery steelhead. Angler catch rate index averaged 12 hours per fish. The percent of the steelhead caught that were hatchery fish ranged from 62% in April to 88% in March. Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead was 600 mm (± 29) for 1-ocean fish and 694 mm (± 10) for 2-ocean fish. Age composition of harvested hatchery steelhead was 10% 1-ocean fish and 90% 2-ocean fish while the sex composition was 21% male and 79% female. On the lower Wallowa River at Rondowa, 26 AdLV+CWT steelhead were harvested from our hatchery releases. Sixty-three percent of the anglers were from Union or Wallowa counties, 32% were from other Oregon counties and 5% were non-residents.

On the upper Wallowa River, we estimated that 2,819 anglers fished for 14,144 hours from 1 February through 15 April 1994. They caught and released an estimated 285 wild and 75 hatchery steelhead and kept an estimated 481 hatchery steelhead. Angler catch rate index averaged 17 hours per fish. The percent of the steelhead caught that were hatchery fish ranged from 56% in February to 69% in April. Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead was 596 mm (± 43) for 1-ocean fish and 704 mm (± 10) for 2-ocean fish. Age composition of harvested hatchery steelhead was 8% 1-ocean fish and 92% 2-ocean fish while the sex composition was 31% male and 69% female. On the upper Wallowa River, 124 AdLV+CWT steelhead were harvested from our hatchery releases. Sixty-five percent of the anglers were from Union or Wallowa counties, 33% were from other Oregon counties and 2% were non-residents.

On the Imnaha River, we estimated that 298 anglers fished for 1,336 hours from 1 March through 15 April 1994. They caught and released an estimated 72 wild steelhead and kept an estimated 29 hatchery steelhead. Angler catch rate index averaged 13 hours per fish. The percent of the steelhead caught that were hatchery fish ranged from 28% in March to 29% in April. Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead was 550 mm for a 1-ocean fish and 694 mm (± 22) for 2-ocean fish. Age composition of harvested hatchery steelhead was 8% 1-ocean fish and 92% 2-ocean fish while the sex composition was 17% male and 83% female. On the

Imnaha River, no AdLV+CWT steelhead were harvested from our hatchery releases. Seventy-six percent of the anglers were from Union or Wallowa counties, 17% were from other Oregon counties and 7% were non-residents.

We found that steelhead harvest estimates from creel surveys were lower than harvest estimates from punch cards but the two estimates are highly correlated.

During the 1993-94 run year, estimates of catch rate, harvest, and angler effort reached median historic levels on the Wallowa River. Estimates of angler effort reached median historic levels on the Grande Ronde River, and catch rate reached median historic levels on the Imnaha River.

After combining fishery statistics from the Grande Ronde, Wallowa, and Imnaha rivers, we found that median values of catch rate, harvest and angler effort were similar between historic and current fisheries. However, we found that the proportion of harvest during the fall and spring was different between historic and current fisheries. In historic fisheries, the percent of total harvest during the fall and spring for all rivers combined was 55% and 45%, respectively. In current fisheries, the percent of total harvest during the fall and spring for all rivers combined was 15% and 85%, respectively.

The proportion of harvest on the Grande Ronde, Wallowa, and Imnaha rivers, was also different between historic and current fisheries. The percent of total harvest in historic fisheries on the Grande Ronde, Wallowa, and Imnaha rivers was 51%, 8% and 41%, respectively. The percent of total harvest in current fisheries on the Grande Ronde, Wallowa, and Imnaha rivers was 31%, 58% and 11%, respectively. Similarly, the percent of total harvest estimated from creel surveys from fisheries on the Grande Ronde, Wallowa, and Imnaha rivers was 39%, 59% and 2%, respectively.

In general, fewer local anglers (Union and Wallowa counties) fished for steelhead during the 1993-94 run year since we began surveys in 1986 (1989 on the upper Grande Ronde River). The number of local anglers on the Wallowa River has dropped consistently for the last six years. In contrast, the number of non-local anglers has steadily increased on the lower Grande Ronde River since surveys began in 1986. The number of out-of-state anglers have remained constant in all steelhead fisheries since 1986.

Management Implications and Recommendations

1. Summer steelhead fisheries during the 1993-94 run year were generally lower than in previous years, based on estimates of angler effort, total catch, and catch rates since surveys began in 1986. This may have been due in part to low adult escapement to both the Grande Ronde and Imnaha basins.
2. During the 1993-94 run year, the steelhead fisheries on the Grande Ronde, Wallowa, and Imnaha rivers compared favorably with historic fisheries. Both catch rate and hours of angler effort reached historic levels in two of the three major fisheries. Harvest exceeded historic median levels in the Wallowa River fishery. Fishery statistics that did not reach historic levels may have been the result of low adult escapement to both the Grande

Ronde and Imnaha basins, as indicated by low adult returns to hatchery facilities. This suggests that the potential exists for additional improvements in the recreational summer steelhead fisheries.

3. After combining fishery statistics from the Grande Ronde, Wallowa, and Imnaha rivers, we found that catch rate, harvest, and hours of angler effort were similar between historic and current fisheries. This suggests that summer steelhead fisheries have been restored to historic levels overall. However, there were differences between historic and current fisheries both in the proportion of harvest during the fall and spring, and within specific fishery areas. This additional analysis suggests that the time and place of summer steelhead fisheries have not been restored to historic conditions. Whether fisheries will be restored to mimic historic levels will depend, in part, upon future management decisions.
4. We found that creel survey harvest estimates were consistently lower than estimates of harvest from punch cards for fisheries on the Grande Ronde, Wallowa and Imnaha rivers. A significant ($P \leq 0.05$) relationship exists between the two estimates, however, and we were able to predict historic creel survey harvest for a comparison with harvest during the 1993-94 run year for fisheries on the Grande Ronde, Wallowa, and Imnaha rivers. Therefore, harvest estimates from creel surveys and from punch cards should not be compared directly.
5. Whether fewer local anglers fishing for steelhead is a real trend over time and the possible causes of the trend should be evaluated more thoroughly.
6. Very few anglers fished for steelhead in the section of the Wallowa River between the mouth of the Lostine River and Trout Creek, which opened for the first time beginning January 1, 1994. This may have been partly due to lower than average adult escapement and to anglers not being familiar with the newly opened area.

INTRODUCTION

Summer steelhead (*Oncorhynchus mykiss*) fisheries in the Grande Ronde and Imnaha basins were closed in 1974. This closure was prompted by declining adult returns, as indicated by adult counts at Ice Harbor Dam on the Snake River (U.S. Army Corps of Engineers 1990), and low steelhead redd counts on index streams in the Grande Ronde and Imnaha basins (U.S. Fish and Wildlife Service, 1991). The Lower Snake River Compensation Plan (LSRCP), initiated by Congress in 1976, was developed to compensate for losses of anadromous salmonids in the Snake River basin from construction of the four lower Snake River Dams built between 1962 and 1976. Thus, the focus of the LSRCP is above Lower Granite Dam (km 173). One of the primary objectives of the LSRCP in Oregon is to restore historic recreational and tribal fisheries for summer steelhead in the Grande Ronde and Imnaha river basins (Carmichael 1989). Approximately 1.68 M smolts are released each year during late April and early May in the Grande Ronde and Imnaha basins. These fish provide hatchery adult returns which contribute to recreational fisheries and may supplement natural spawning populations in northeast Oregon. Consumptive recreational fisheries

for summer steelhead re-opened in 1986, in part, as a result of increases in hatchery adult returns.

We began our creel surveys for summer steelhead during the fall of 1985 in both the Grande Ronde and Imnaha basins. The goal of the creel surveys are to provide annual harvest information needed to assess LSRCP objectives and compensation goals (Carmichael and Wagner 1983). Previously, total harvest was estimated only from angler punch card returns. This report summarizes results of creel surveys conducted during the fall of 1993 and spring of 1994 in the Grande Ronde and Imnaha basins. These areas represent the major steelhead fisheries in Oregon that occur in streams which drain into the Snake River upstream of Lower Granite Dam. To determine whether recreational fisheries have been restored, we combined data from the historic recreational summer steelhead fisheries on the Grande Ronde, Wallowa, and Imnaha rivers and compared these to current fishery data from the same combined areas. We then examined the specific time when fisheries occurred from the combined data sets. We evaluated the restoration of the fisheries further by examining specific fishery areas. Results of creel surveys conducted prior to fall 1993 are reported in previous LSRCP evaluation annual reports (Carmichael et al. 1986, 1987, 1988, 1989, and 1990a; Flesher et al. 1991, 1992 and 1994). The steelhead angling season surveyed in this report, during which only adipose-clipped fish could be kept, was open from 1 September 1993 to 15 April 1994 in the Grande Ronde and Imnaha basins.

STUDY AREA

Creel surveys on the Grande Ronde River were conducted on a 23.5 km section on the lower river from the Oregon-Washington state line (km 62.3) to Wildcat Creek (km 85.8) and an upper 39.3 km section from Highway 82 bridge at Island City (km 255.6) to Meadow Creek (km 294.8). Surveys on the Wallowa River were conducted on a 5.5 km section on the lower river from its confluence with the Grande Ronde River at Rondowa (km 0) to Howard Creek (km 5.5) and an upper 49.4 km section from Minam State Park (km 13.2) to the mouth of Trout Creek (km 62.6) near Enterprise. The Wallowa River fishery was extended from the mouth of the Lostine River (km 41.8) to the mouth of Trout Creek beginning January 1, 1994. Anglers who parked their vehicles at Minam State Park to fish at or just below the park were included in the survey. The survey on the Imnaha River was conducted on the lower 31.5 km from its confluence with the Snake River (km 0) to the mouth of Big Sheep Creek (km 31.5) near the town of Imnaha. These areas are shown in Figure 1.

METHODS

Angler Surveys

Generally, we followed the methods described by Carmichael et al. (1988). We sampled 50% of the weekends/holidays and 30% of the weekdays during each month of each survey for a total of 157 sample days. Initially, sample days were chosen randomly. They were then adjusted so that, as much as possible, weekend days and holidays were represented equally and weekdays were represented equally. Each sample day the creel surveyor conducted a pressure count which involved driving a vehicle along the entire survey route while

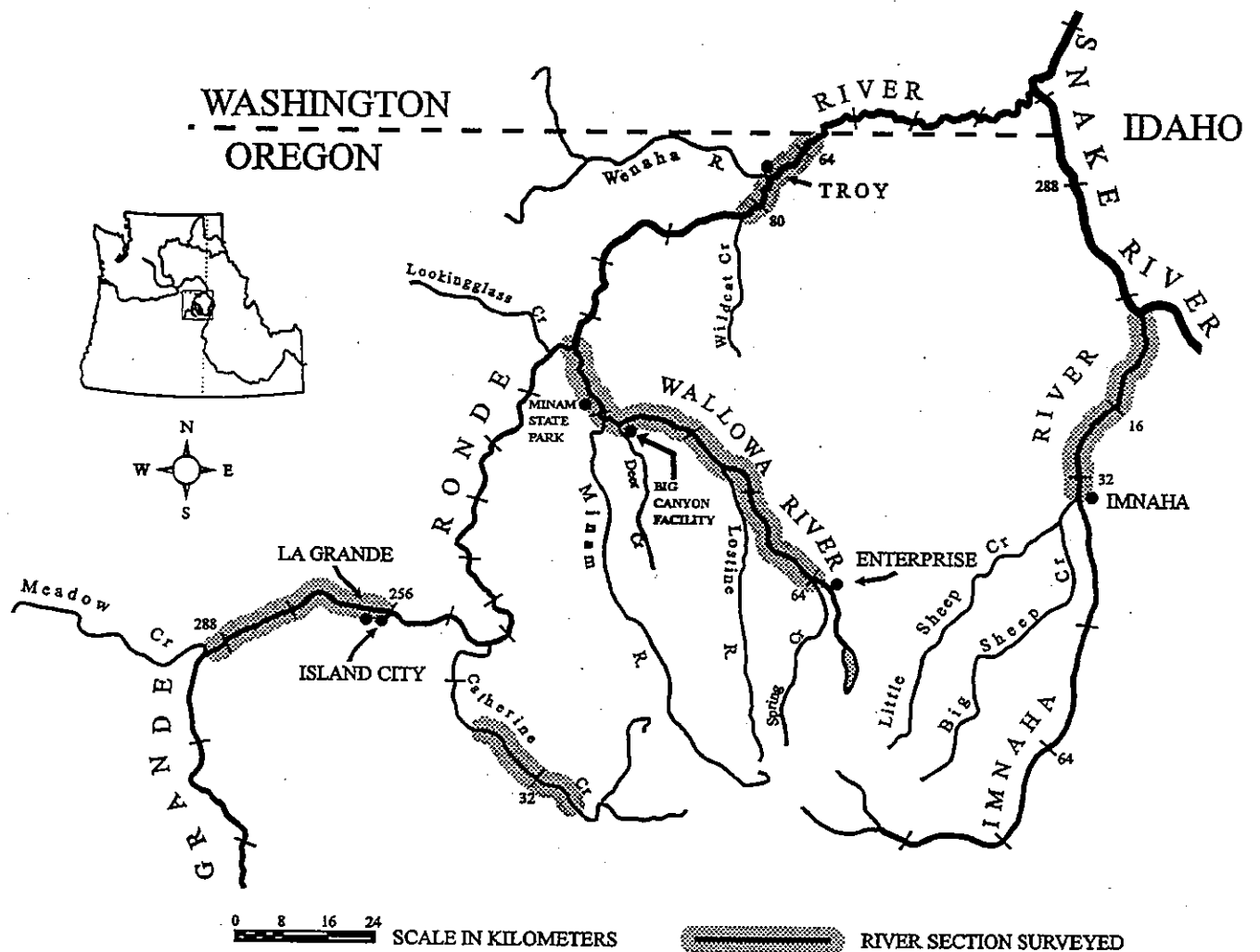


Figure 1. Map of northeastern Oregon showing where summer steelhead creel surveys were conducted in the Grande Ronde and Imnaha basins during the 1993-94 run year.

tallying all anglers and vehicles every three hours, beginning with a randomly selected start time. Between pressure counts, the surveyor interviewed anglers; recording descriptions of each angler or their vehicle and their residence, the number of hours fished, and number and species caught. They also sampled all harvested fish; recording fork length, sex, fin clip, external tags and collected scale samples. If the fish was coded-wire-tagged, as indicated by an adipose fin clip and left ventral (pelvic) fin clip (AdLV+CWT), the surveyor excised the head behind the eye and placed it with an identification number in a plastic bag for later processing. The Imnaha River and Rondowa fisheries were surveyed using check stations where the surveyor parked their vehicle in a highly visible location and set up an angler check station sign. The check station was designed so that anglers leaving the fishery area during a sample day would stop voluntarily and the surveyor would interview each angler and sample all harvested fish. From all creel surveys, we estimated total catch, harvest, catch rate, angler effort in hours and days, the percent of hatchery fish in the catch, and the number of AdLV+CWT fish harvested (Carmichael et al. 1988). In addition, we determined the age and sex composition and mean fork length of harvested fish, and the residence of anglers in each fishery. Catch rate is an index, expressed as hours per fish, which results in lower catch rates reflecting better angling success. The survey on the lower Grande Ronde River was from 1 September to 31 December 1993 and from 1 February to 15 April 1994. The survey on the upper Wallowa River was from 1 February to 15 April 1994. The survey on the upper Grande Ronde River and the lower Wallowa River at Rondowa was from 16 February to 15 April 1994. The survey on the Imnaha River was from 1 March to 15 April 1994.

Historic Fisheries

Fishery statistics used to document historic (prior to and including 1973-74 run year) recreational fisheries include catch rate, harvest and hours of angler effort. Estimates of catch rate were found in the Oregon Department of Fish and Wildlife, LaGrande and Wallowa district, annual reports from 1948-74. Estimates of harvest were found in Oregon Department of Fish and Wildlife angler punch card summary tables, titled "ODFW Salmon and Steelhead Catch Data", from 1956-74. We calculated historic angler effort by multiplying catch rate by harvest for each year data were available. Most historic harvest and catch rate data did not distinguish between lower and upper areas of the Grande Ronde River, or between lower (Rondowa) and upper areas on the Wallowa River. Therefore, we pooled these and defined fishery areas as the Grande Ronde, Wallowa, and Imnaha rivers.

Current Fisheries

Fishery statistics used to document current (1985-86 to 1993-94 run years) recreational fisheries include catch rate and hours of angler effort estimated from creel surveys. To provide direct comparisons to historic harvest, we documented current harvest using angler punch card estimates from 1985-86 through the 1992-93 run years. To compare timing of individual fisheries, we used harvest estimates from creel surveys for the 1985-86 to 1993-94 run years. To be comparable to historic fisheries, fishery areas included the Grande Ronde (includes upper and lower Grande Ronde River

surveys), Wallowa (includes Rondowa, and upper Wallowa River surveys), and Imnaha (includes Imnaha survey) rivers.

Comparison of Historic and Current Fisheries

To determine if recreational steelhead fisheries during the 1993-94 run year reached or exceeded historic fishery levels, we compared catch rate, harvest, and angler effort estimates to historic estimates from the Grande Ronde, Wallowa, and Imnaha rivers. Historic harvest was estimated from punch card data. At present, the only estimates of harvest for the 1993-94 run year were from creel surveys, because punch card data is complete only through the 1992-93 run year. Since creel survey harvest estimates are related to but not the same as punch card harvest estimates (Jonasson and Lindsay 1988; Kenaston 1989; Mendel et al. 1988; Olsen et al. 1991), it may not be appropriate to compare historic punch card data to 1993-94 creel data. We therefore used regression analyses of creel survey and punch card harvest (1986-87 to 1992-93 run years) to predict what the historic creel survey harvest would have been. This allowed us to compare the 1993-94 and historic estimates of harvest. In addition, to determine whether recreational steelhead fisheries have been restored to historic levels, we combined information from the Grande Ronde, Wallowa, and Imnaha river fisheries on catch rate, harvest, and hours of angler effort to compare the overall historic fishery to the overall current fishery. Yearly estimates of harvest and hours of angler effort were summed for all fisheries. Yearly estimates of catch rate were weighted by angler effort for each fishery. Median values were then determined for the overall fishery. We used punch card data to compare the historic and current proportions of overall harvest that occurred during the fall and spring. Finally, we used punch card harvest and creel survey harvest to compare the seasonality of historic and current harvest from each of the Grande Ronde, Wallowa, and Imnaha river fisheries.

Historical and current median values were compared using Mann-Whitney Test (Snedecor and Cochran 1967). Proportions of historic and current punch card harvest during the fall and spring from combined fisheries, and between areas were compared using Chi-Square tests. Values were considered significantly different when $P \leq 0.05$.

RESULTS

1993-94 Run Year

Lower Grande Ronde River

We estimated that 2,607 anglers fished for 12,883 hours on the lower Grande Ronde River. They caught and released 483 wild and 84 hatchery steelhead and kept 168 hatchery steelhead for a catch rate index of 18 hours per fish (Figures 2-6, Appendix A-1). The percent of the steelhead caught that were hatchery fish ranged from 11% in March 1994 to 67% in April 1994 (Figure 7, Appendix B). Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead ranged from 583 mm (± 286) for 1-ocean females to 743 mm (± 35) for 2-ocean males (Table 1). Age composition of harvested

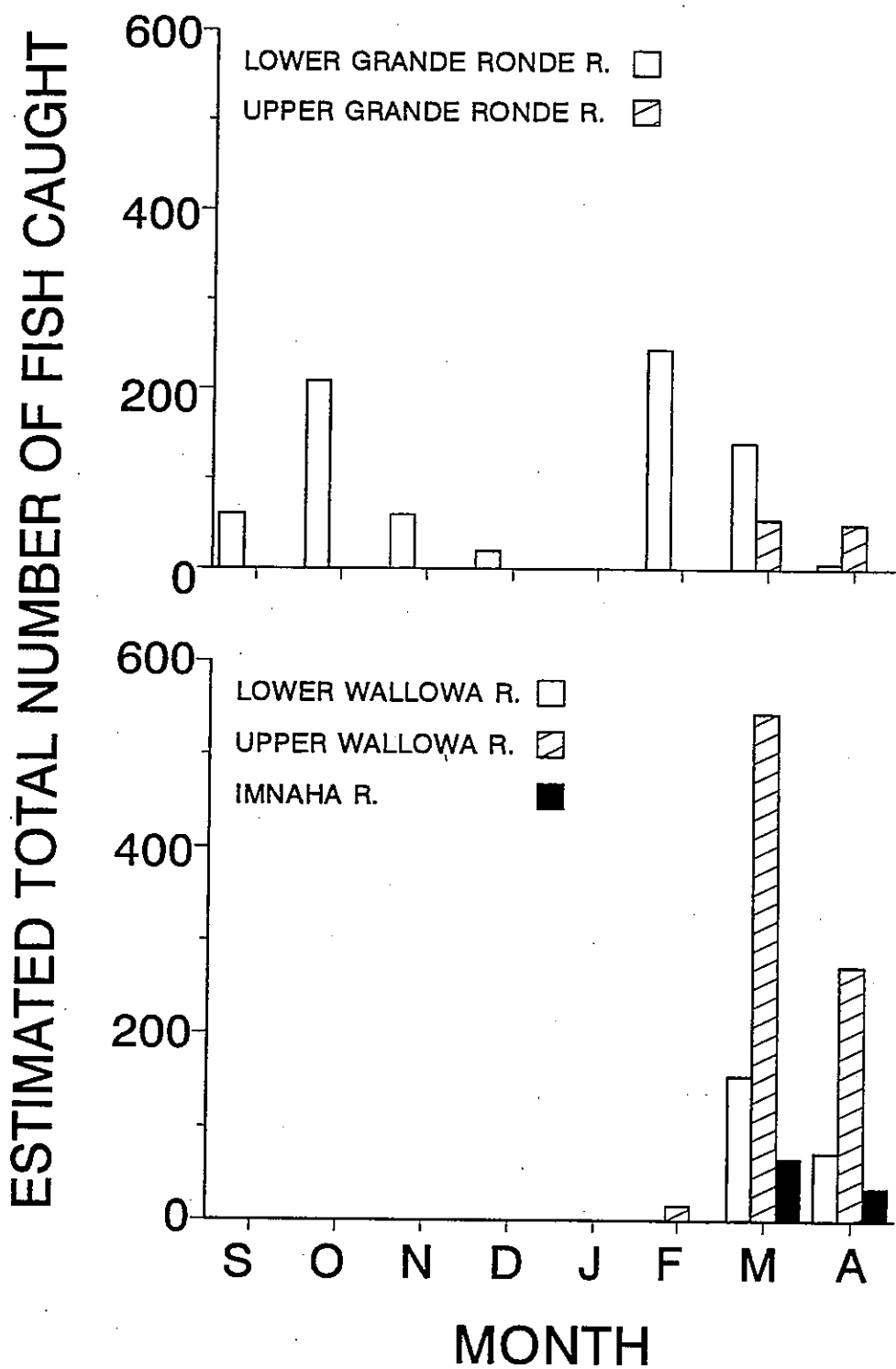


Figure 2. Estimated total catch of summer steelhead in the Grande Ronde and Imnaha basins during the 1993-94 run year. Survey areas and times include the lower Grande Ronde (1 September-15 April), upper Wallowa (1 February-15 April), upper Grande Ronde and lower Wallowa (16 February-15 April), and Imnaha (1 March-15 April) rivers. NS indicates not sampled.

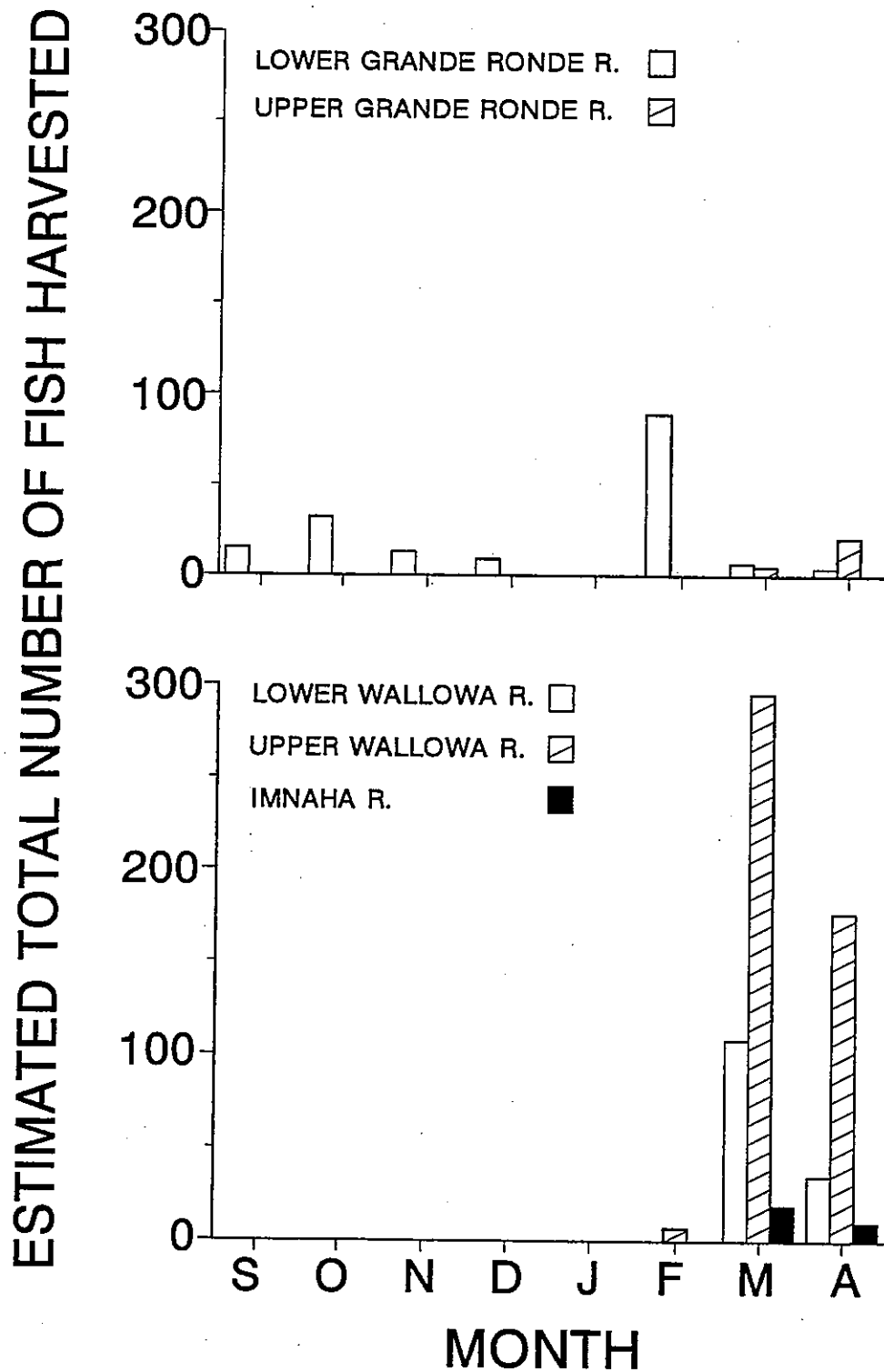


Figure 3. Estimated total harvest of summer steelhead in the Grande Ronde and Imnaha basins during the 1993-94 run year. Survey areas and times include the lower Grande Ronde (1 September-15 April), upper Wallowa (1 February-15 April), upper Grande Ronde and lower Wallowa (16 February-15 April), and Imnaha (1 March-15 April) rivers. NS indicates not sampled.

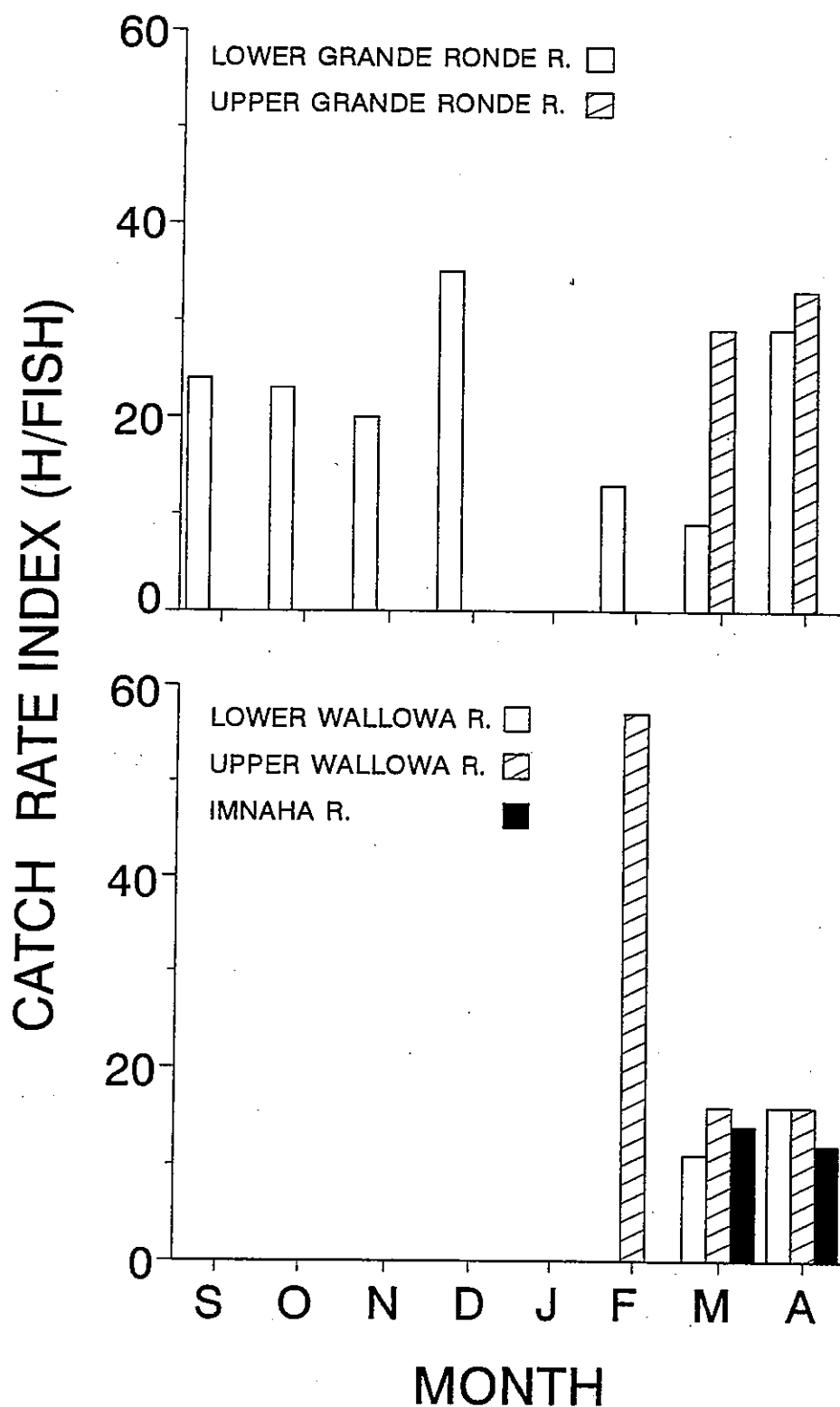


Figure 4. Estimated catch rate index (h/fish) for summer steelhead in the Grande Ronde and Imnaha basins during the 1993-94 run year. Survey areas and times include the lower Grande Ronde (1 September-15 April), upper Wallowa (1 February-15 April), upper Grande Ronde and lower Wallowa (16 February-15 April), and Imnaha (1 March-15 April) rivers. NS indicates not sampled. Note: Low catch rate implies better angling success.

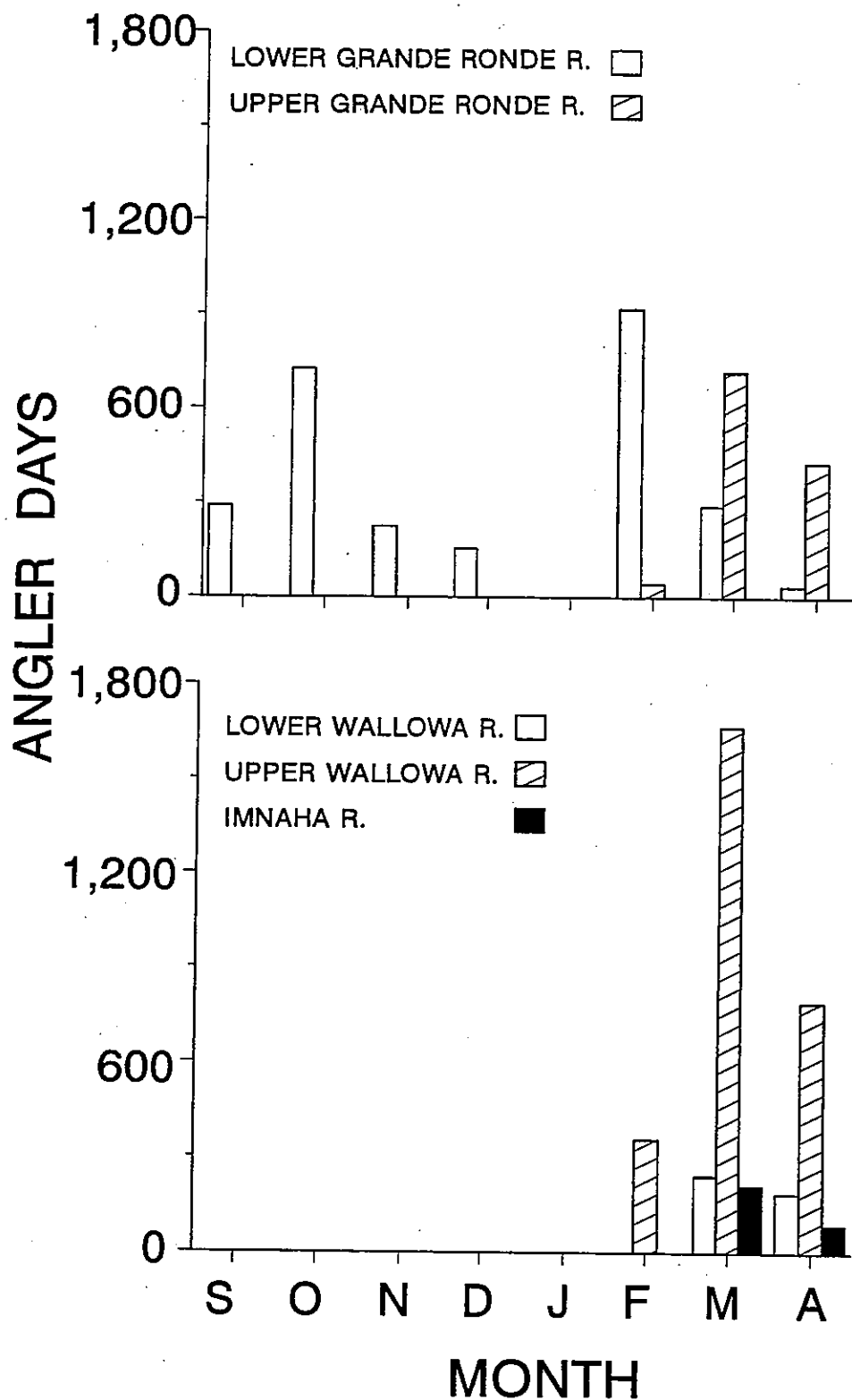


Figure 5. Estimated number of angler days for summer steelhead in the Grande Ronde and Imnaha basins during the 1993-94 run year. Survey areas and times include the lower Grande Ronde (1 September-15 April), upper Wallowa (1 February-15 April), upper Grande Ronde and lower Wallowa (16 February-15 April), and Imnaha (1 March-15 April) rivers. NS indicates not sampled.

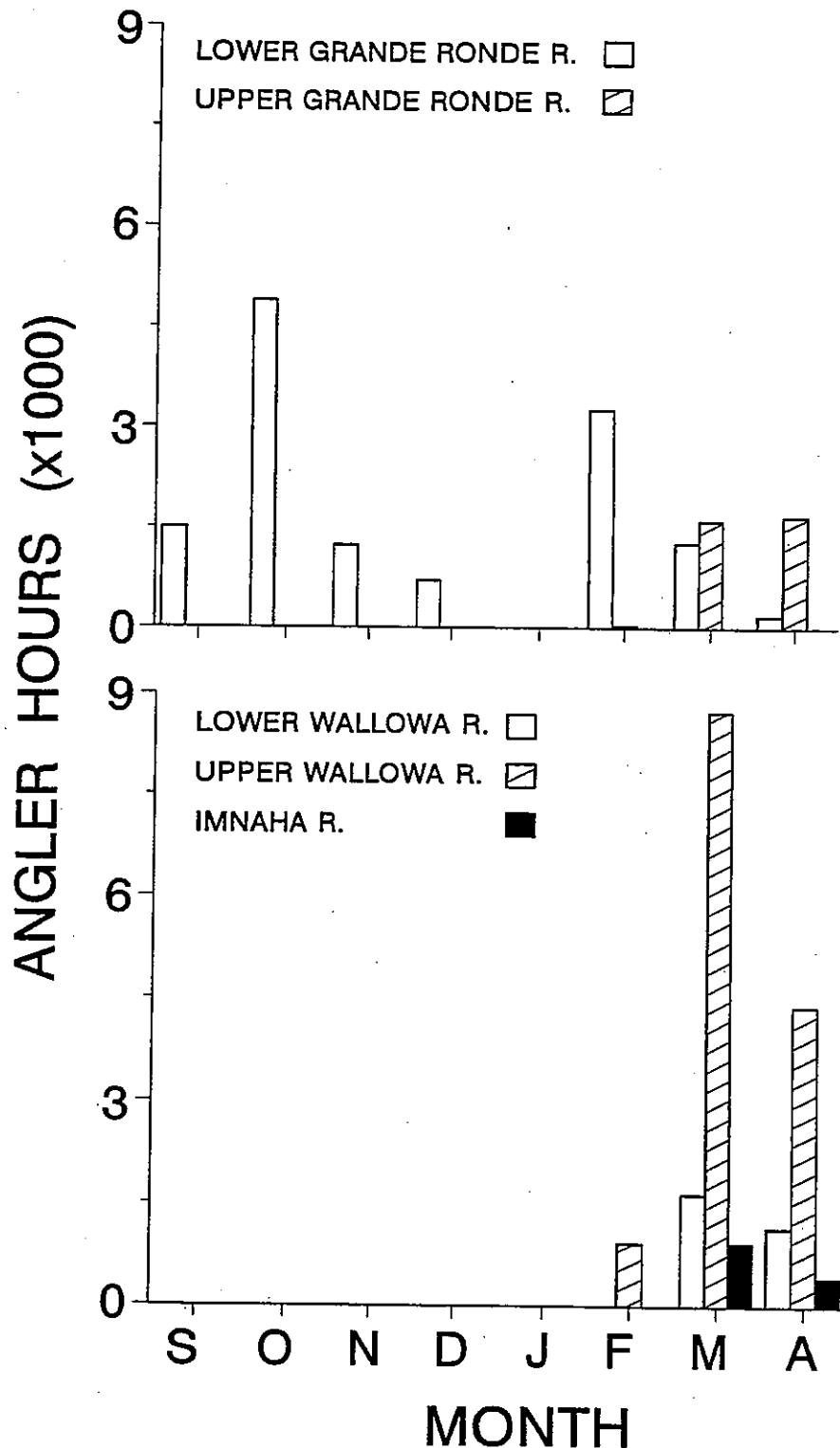


Figure 6. Estimated number of angler hours for summer steelhead in the Grande Ronde and Imnaha basins during the 1993-94 run year. Survey areas and times include the lower Grande Ronde (1 September-15 April), upper Wallowa (1 February-15 April), upper Grande Ronde and lower Wallowa (16 February-15 April), and Imnaha (1 March-15 April) rivers. NS indicates not sampled.

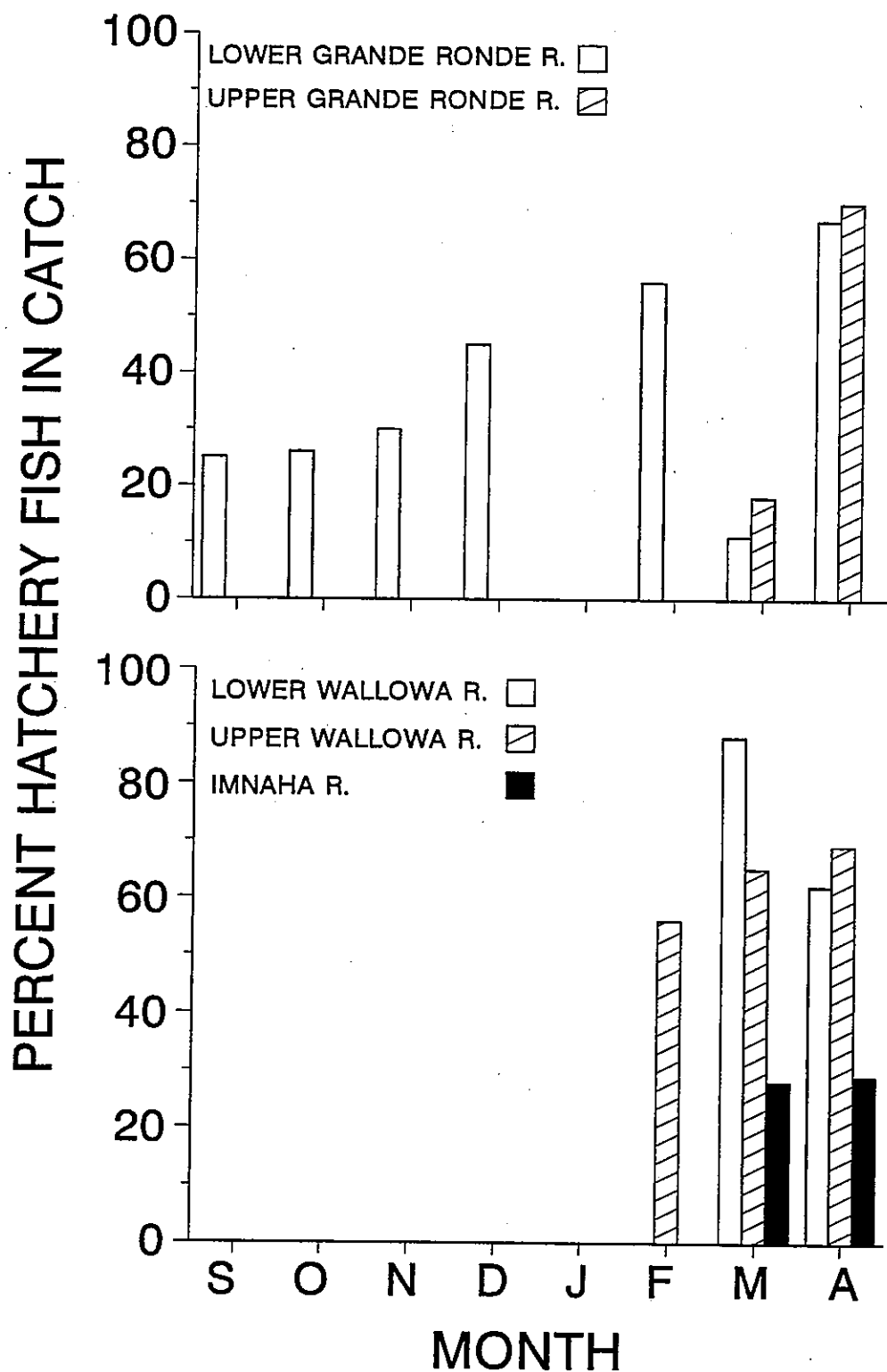


Figure 7. Estimated percent of the summer steelhead caught in the Grande Ronde and Imnaha basins during the 1993-94 run year that were hatchery fish. Survey areas and times include the lower Grande Ronde (1 September-15 April), upper Wallowa (1 February-15 April), upper Grande Ronde and lower Wallowa (16 February-15 April), and Imnaha (1 March-15 April) rivers. NS indicates not sampled.

Table 1. Percent age composition and mean fork length of summer steelhead sampled in creel surveys in the Grande Ronde and Imnaha basins during the 1993-94 run year. Mean fork length includes $\pm 95\%$ confidence interval. Age is expressed as years spent in freshwater prior to ocean migration: years spent in the ocean prior to spawning migration.

Survey area, sex	Age composition (%)			Mean Fork length (mm)			
	N	1:1	1:2	N	1:1	N	1:2
Lower Grande Ronde							
Male	4	0	100	0	--	4	743 \pm 35
Female	13	15	85	2	583 \pm 286	11	689 \pm 16
unknown	1	0	100	0	--	1	655
Total	18	11	89	2	583 \pm 286	16	700 \pm 18
Upper Grande Ronde							
Male	1	100	0	1	585	0	--
Female	3	0	100	0	--	3	688 \pm 56
Total	4	25	75	1	585	3	688 \pm 56
Lower Wallowa at Rondowa							
Male	10	10	90	1	624	9	727 \pm 19
Female	38	10	90	4	594 \pm 34	34	685 \pm 10
Total	48	10	90	5	600 \pm 29	43	694 \pm 10
Upper Wallowa							
Male	18	11	89	2	574 \pm 445	16	726 \pm 23
Female	40	8	92	3	611 \pm 49	37	693 \pm 9
unknown	1	0	100	0	--	1	760
Total	59	8	92	5	596 \pm 43	54	704 \pm 10
Imnaha							
Male	2	0	100	0	--	2	685 \pm 318
Female	10	10	90	1	550	9	696 \pm 26
Total	12	8	92	1	550	11	694 \pm 22

hatchery steelhead was 11% 1-ocean fish and 89% 2-ocean fish while the sex composition was 24% male and 76% female (Table 1). On the lower Grande Ronde River, anglers harvested 31 adipose-left ventral clipped plus coded-wire-tagged (AdLV+CWT) steelhead from our hatchery releases (Table 2). Sixty-three percent of the anglers were from Union or Wallowa counties, 25% were from other Oregon counties and 12% were non-residents (Table 3).

Upper Grande Ronde River

On the upper Grande Ronde River, we estimated that 1,172 anglers fished for 3,230 hours. They caught and released 59 wild and 18 hatchery steelhead and kept 26 hatchery steelhead for a catch rate index of 31 hours per fish

Table 2. Observed and expanded number of AdLV+CWT summer steelhead recovered in the Grande Ronde and Imnaha basins during the 1993-94 run year. No AdLV+CWT fish were recovered in the upper Grande Ronde or Imnaha rivers. Tag recoveries were expanded for the entire fishery.

Creel survey area	Tag code	Experimental Group	Brood Year	Number recovered		% of release ^a
				Observed	Expanded	
Lower Grande Ronde	07 53 52	Acclimated	90	2	10	0.04
	07 53 53	Direct Stream	90	1	2	0.01
	07 53 59	4/1b	90	1	7	0.03
	07 53 60	4/1b	90	1	4	0.01
	07 54 43	5/1b	90	1	4	0.01
	07 54 44	5/1b	90	1	4	0.01
Lower Wallowa at Rondowa	07 53 51	Acclimated	90	3	7	0.03
	07 53 52	Acclimated	90	1	2	0.01
	07 53 53	Direct Stream	90	1	3	0.01
	07 53 59	4/1b	90	1	3	0.01
	07 53 60	4/1b	90	2	5	0.02
	07 54 43	5/1b	90	1	3	0.01
	07 54 44	5/1b	90	1	3	0.01
Upper Wallowa	07 53 51	Acclimated	90	4	33	0.13
	07 53 52	Acclimated	90	5	45	0.17
	07 53 53	Direct Stream	90	1	8	0.03
	07 53 59	4/1b	90	1	8	0.03
	07 53 60	4/1b	90	1	10	0.04
	07 54 43	5/1b	90	2	20	0.07

^a Percent of release is based on expanded number of AdLV+CWT fish recovered.

Table 3. Residence of summer steelhead anglers interviewed during creel surveys in the Grande Ronde and Imnaha basins during the 1993-94 run year.

Creel survey area	Number of anglers	Percent from		
		Wallowa and Union counties	Other Oregon counties	Out-of-state
Lower Grande Ronde	797	63	25	12
Upper Grande Ronde	310	93	5	2
Lower Wallowa at Rondowa	174	63	32	5
Upper Wallowa	532	65	33	2
Imnaha	134	76	17	7

(Figures 2-6, Appendix A-2). The percent of the steelhead caught that were hatchery fish ranged from 17% in March to 70% in April (Figure 7, Appendix B). Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead ranged from 585 mm for a 1-ocean male to 688 mm (± 56) for 2-ocean females (Table 1). Age composition of harvested hatchery steelhead was 25% 1-ocean fish and 75% 2-ocean fish while the sex composition was 25% male and 75% female (Table 1). No AdLV+CWT steelhead were harvested on the upper Grande Ronde River (Table 2). Ninety-three percent of the anglers were from Union or Wallowa counties, 5% were from other Oregon counties and 2% were non-residents (Table 3).

Lower Wallowa River at Rondowa

On the lower Wallowa River at Rondowa, we estimated that 426 anglers fished for 2,782 hours. They caught and released 47 wild and 38 hatchery steelhead and kept 143 hatchery steelhead for a catch rate index of 12 hours per fish (Figures 2-6, Appendix A-3). The percent of the steelhead caught that were hatchery fish ranged from 62% in April to 88% in March (Figure 7, Appendix B). Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead ranged from 594 mm (± 34) for 1-ocean females to 727 mm (± 19) for 2-ocean males (Table 1). Age composition of harvested hatchery steelhead was 10% 1-ocean fish and 90% 2-ocean fish while the sex composition was 21% male and 79% female (Table 1). On the lower Wallowa River at Rondowa, anglers harvested 26 AdLV+CWT steelhead from our hatchery releases (Table 2). Sixty-three percent of the anglers were from Union or Wallowa counties, 32% were from other Oregon counties and 5% were non-residents (Table 3).

Upper Wallowa River

On the upper Wallowa River, we estimated that 2,819 anglers fished for 14,144 hours. They caught and released 285 wild and 75 hatchery steelhead and kept 481 hatchery steelhead for a catch rate index of 17 hours per fish (Figures 2-6, Appendix A-5). The percent of the steelhead caught that were hatchery fish ranged from 56% in February to 69% in April (Figure 7, Appendix B). Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead ranged from 574 mm (± 445) for 1-ocean males to 760 mm for a 2-ocean male (Table 1). Age composition of harvested hatchery steelhead was 8% 1-ocean fish and 92% 2-ocean fish while the sex composition was 31% male and 69% female (Table 1). On the upper Wallowa River, anglers harvested 124 AdLV+CWT steelhead from our hatchery releases (Table 2). Sixty-five percent of the anglers were from Union or Wallowa counties, 33% were from other Oregon counties and 2% were non-residents (Table 3).

Imnaha River

On the Imnaha River, we estimated that 298 anglers fished for 1,336 hours. They caught and released 72 wild steelhead and kept 29 hatchery steelhead for a catch rate index of 13 hours per fish (Figures 2-6, Appendix A-6). The percent of the steelhead caught that were hatchery fish ranged from 28% in March to 29% in April (Figure 7, Appendix B). Mean fork length ($\pm 95\%$ confidence interval) of harvested hatchery steelhead ranged from 550 mm for a 1-ocean female to 696 mm (± 26) for 2-ocean females (Table 1). Age composition of harvested hatchery steelhead was 8% 1-ocean fish and 92% 2-ocean fish while the sex composition was 17% male and 83% female (Table 1). No AdLV+CWT

steelhead were harvested on the Imnaha River (Table 2). Seventy-six percent of the anglers were from Union or Wallowa counties, 17% were from other Oregon counties and 7% were non-residents (Table 3).

Historic Fisheries

On the Grande Ronde River, the historic median catch rate index, harvest, and angler effort was 14.2 hours per fish, 764 fish, and 11,408 angler hours, respectively (Table 4). On the Wallowa River, the historic median catch rate index, harvest, and angler effort was 35.2 hours per fish, 122 fish, and 3,016 angler hours, respectively. On the Imnaha River, the historic median catch rate index, harvest, and angler effort was 15.1 hours per fish, 627 fish, and 10,605 angler hours, respectively. The historic median catch rate index, harvest, and angler effort for the Grande Ronde, Wallowa, and Imnaha rivers combined was 16.1 hours per fish, 1,662 fish, and 30,651 angler hours, respectively. The historic median harvest during the fall and spring for the Grande Ronde, Wallowa, and Imnaha rivers combined was 854 fish and 687 fish respectively.

Current Fisheries

The current median catch rate index, punch card harvest, creel survey harvest and angler effort for the Grande Ronde, Wallowa, and Imnaha rivers combined was 15.1 hours per fish, 1,679 fish, 790 fish, and 40,315 angler hours, respectively (Table 4). The current median harvest during the fall and spring for the Grande Ronde, Wallowa, and Imnaha rivers combined was 258 fish and 1,421 fish, respectively. The current (1986-87 to 1992-93 run year)

Table 4. Median values of historic and current estimates of catch rate index, punch card harvest, creel survey harvest, and hours of angler effort for summer steelhead recreational fisheries on the Grande Ronde, Wallowa, and Imnaha rivers. (Median values for combined fisheries were determined after data sets from each fishery or season were combined, not by summing the median values from each fishery or season).

Area	Catch rate index hours/fish	Punch card harvest			Creel survey harvest	Angler hours
		Fall	Spring	Combined		
Historic						
Grande Ronde	14.2	--	--	764	--	11,408
Wallowa	35.2	--	--	122	--	3,016
Imnaha	15.1	--	--	627	--	10,605
Combined	16.1	854	687	1,662	--	30,651
Current						
Grande Ronde	--	--	--	608	421	--
Wallowa	--	--	--	1,160	641	--
Imnaha	--	--	--	212	19	--
Combined	15.1	258	1,421	1,679	790	40,315

median punch card harvest was 608 fish, 1,160 fish, and 212 fish for the Grande Ronde, Wallowa, and Imnaha rivers, respectively. The current (1986-87 to 1993-94 run year) median creel survey harvest was 421 fish, 641 fish, and 19 fish for the Grande Ronde, Wallowa, and Imnaha rivers, respectively.

Predicting Historic Creel Survey Harvest from Punch Card Harvest

Historic median punch card harvest was 764, 122, and 627 fish for the Grande Ronde, Wallowa, and Imnaha rivers, respectively. Creel survey harvest was highly correlated to punch card harvest estimates for summer steelhead fisheries on the Grande Ronde, Wallowa, and Imnaha rivers for the 1986-87 through 1992-93 run years (Figure 8). The regression equations used to predict historic creel survey harvest estimates from punch card harvest estimates for the (1) Grande Ronde, (2) Wallowa, and (3) Imnaha river fisheries were as follows:

- (1) Creel survey harvest = 0.30 (punch card harvest) + 58.37; $r^2 = 0.97$; $P < 0.001$
- (2) Creel survey harvest = 0.51 (punch card harvest) - 26.53; $r^2 = 0.89$; $P = 0.015$
- (3) Creel survey harvest = 0.29 (punch card harvest) - 20.15; $r^2 = 0.83$; $P = 0.011$

Predicted creel survey harvest for historic fisheries on the Grande Ronde, Wallowa, and Imnaha rivers was 288, 36, and 162 fish, respectively.

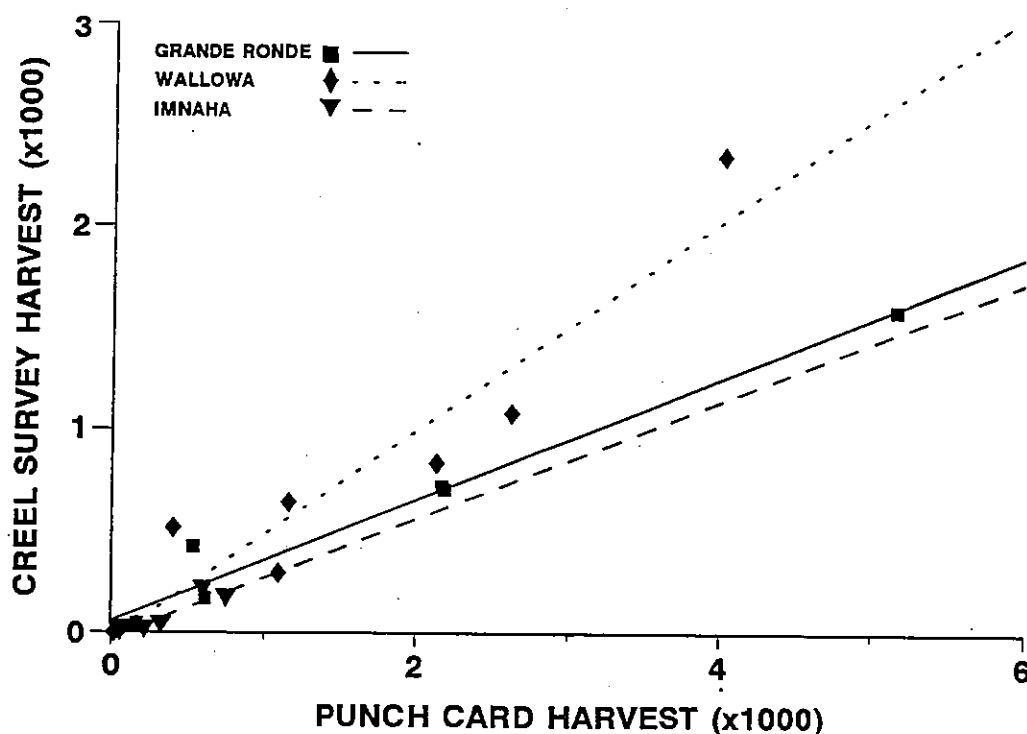


Figure 8. Relationship of creel survey and punch card harvest estimates for summer steelhead fisheries on the Grande Ronde, Wallowa, and Imnaha rivers for the 1986-87 to 1992-93 run years.

DISCUSSION

1993-94 Run Year

We estimated that during the 1993-94 run year, angler effort was below the average since consumptive recreational steelhead fisheries re-opened and creel surveys began in 1986 in the Grande Ronde and Imnaha basins (Figure 9). Estimated harvest was also below average (Figure 10) as was estimated total catch since creel surveys began. Catch rates were poor in both the lower and upper Grande Ronde river fisheries, and were the second lowest since surveys began in 1986. On the Wallowa (at Rondowa and above) and Imnaha rivers, catch rates were the lowest they have been in four years. The percent of hatchery fish in the catch in all fisheries was the lowest since surveys began in 1986, probably due, in part, to low hatchery adult returns. A higher proportion of 2-ocean than 1-ocean steelhead were harvested in the Grande Ronde and Imnaha basin fisheries during the 1993-94 run year. Age composition of harvested hatchery fish was 10% 1-ocean and 90% 2-ocean fish, compared to an average of 70% 1-ocean and 30% 2-ocean fish harvested in these fisheries from 1987 to 1993. This may have been partly due to low 1-ocean hatchery adult returns to both basins in 1994 (Messmer et al. in preparation), and suggests that the 1991 brood year (1-ocean adult returns) had low smolt-to-adult survival. Summer steelhead harvested during the 1993-94 run year in the Grande Ronde and Imnaha basin fisheries were similar in size to those harvested each year since surveys began in 1986, with fork lengths averaging 592 mm for 1-ocean and 699 mm for 2-ocean fish. The number of local anglers (from Union and Wallowa counties) fishing for steelhead on the Wallowa River has dropped steadily for the last six years (since the 1987-88 run year). In addition, fewer local anglers in more recent years have been fishing for steelhead in the upper and lower Grande Ronde and Imnaha river fisheries. This seems to suggest a declining trend in local angling interest in fisheries in the Grande Ronde and Imnaha basins. In contrast, the number of non-local Oregon anglers has steadily increased on the lower Grande Ronde River since surveys began in 1986. The number of out-of-state anglers have remained constant in all fisheries since 1986. These possible trends over time should be evaluated more thoroughly.

The 1993-94 steelhead fishery compared favorably with historic fisheries. Catch rates on both the Wallowa and Imnaha rivers were better than historic median catch rates (Figure 11). Hours of angler effort on the Grande Ronde and Wallowa rivers were higher than historic median values (Figure 12). However, harvest was higher than the historic median value only on the Wallowa River (Figure 13), based on the predicted historic creel survey harvest. Fishery statistics that did not reach historic median values, included catch rate on the Grande Ronde River, angler effort on the Imnaha River and harvest on both the Grande Ronde and Imnaha rivers, may have been the result of low adult steelhead returns during the 1993-94 run year (Messmer et al. in preparation), and to a redistribution of angler effort between fishery areas.

Comparison of Historic and Current Fisheries

Comparisons of fishery statistics from steelhead fisheries for all rivers combined indicated that historic and current summer steelhead fisheries were similar. We found no difference in median values between historic and

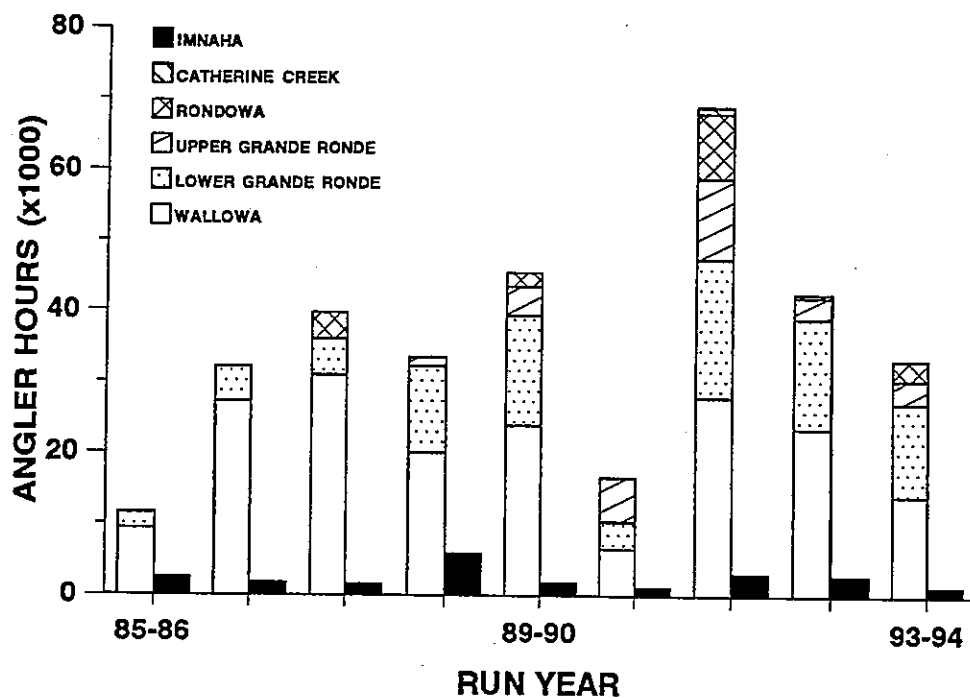


Figure 9. Angler effort for summer steelhead in the Grande Ronde and Imnaha basins from 1986-94.

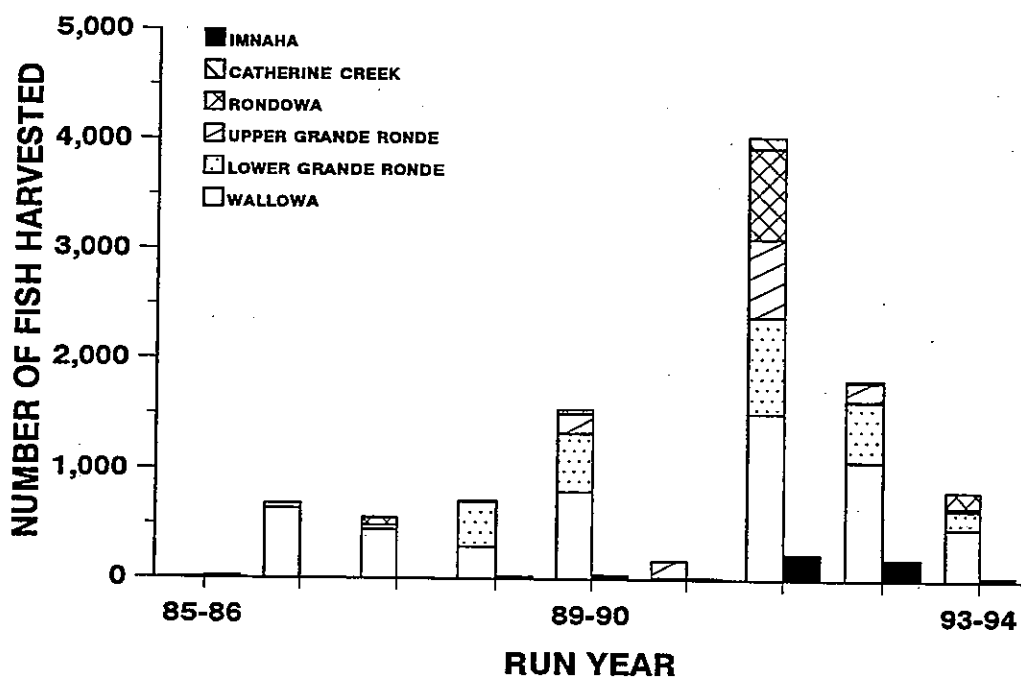


Figure 10. Number of hatchery summer steelhead harvested by recreational anglers in the Grande Ronde and Imnaha basins from 1986-94.

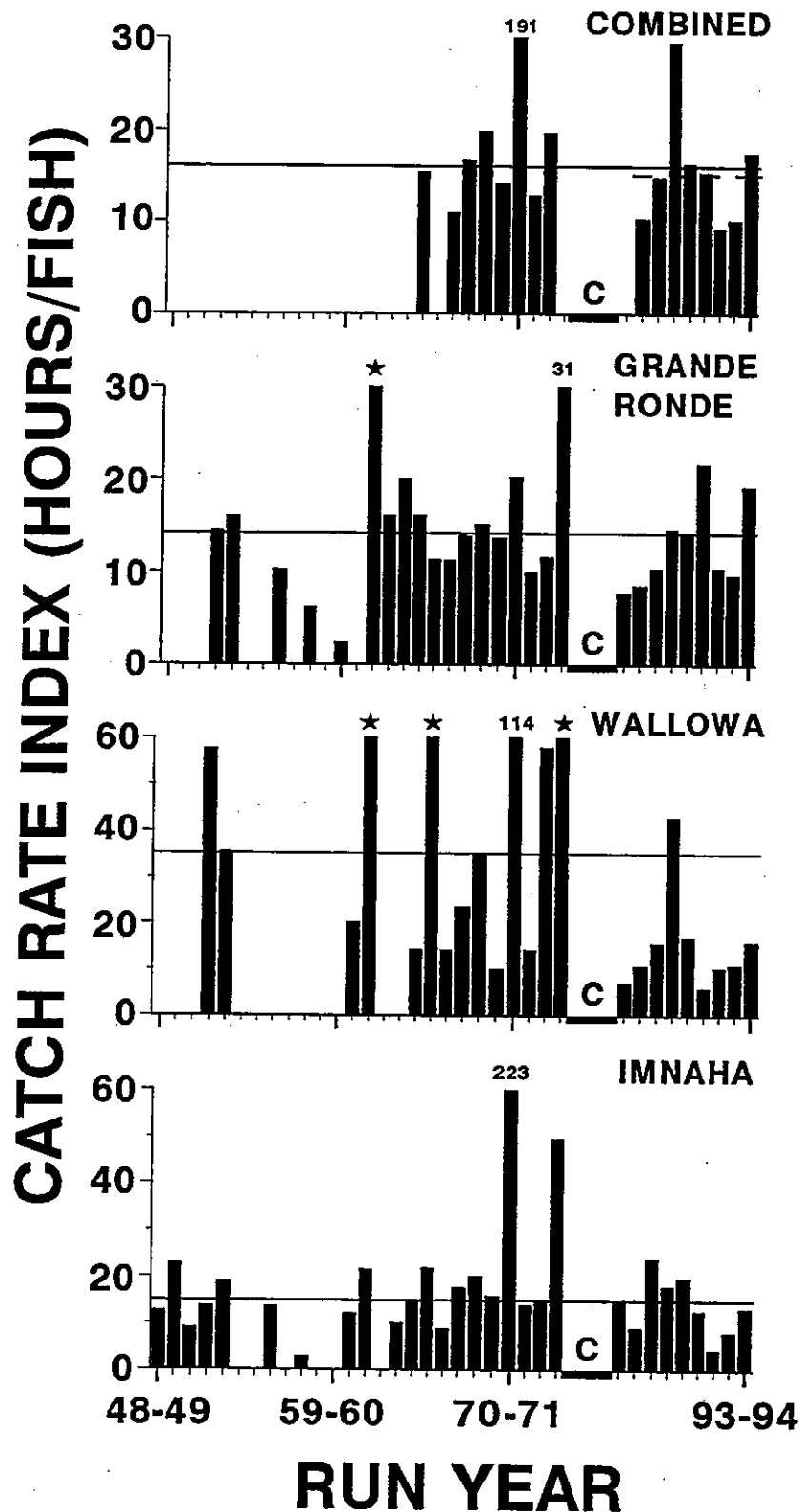


Figure 11. Historic (1949-74) and current (1986-94) catch rate indexes for recreational fisheries on the Grande Ronde, Wallowa, and Imnaha rivers individually and combined. Solid line = historic median. Dashed line = current median. ★ = effort with no catch which results in an undefined catch rate. C = fishery closed. No bars or symbols = data incomplete or unavailable. Note: Low catch rate implies better angling success.

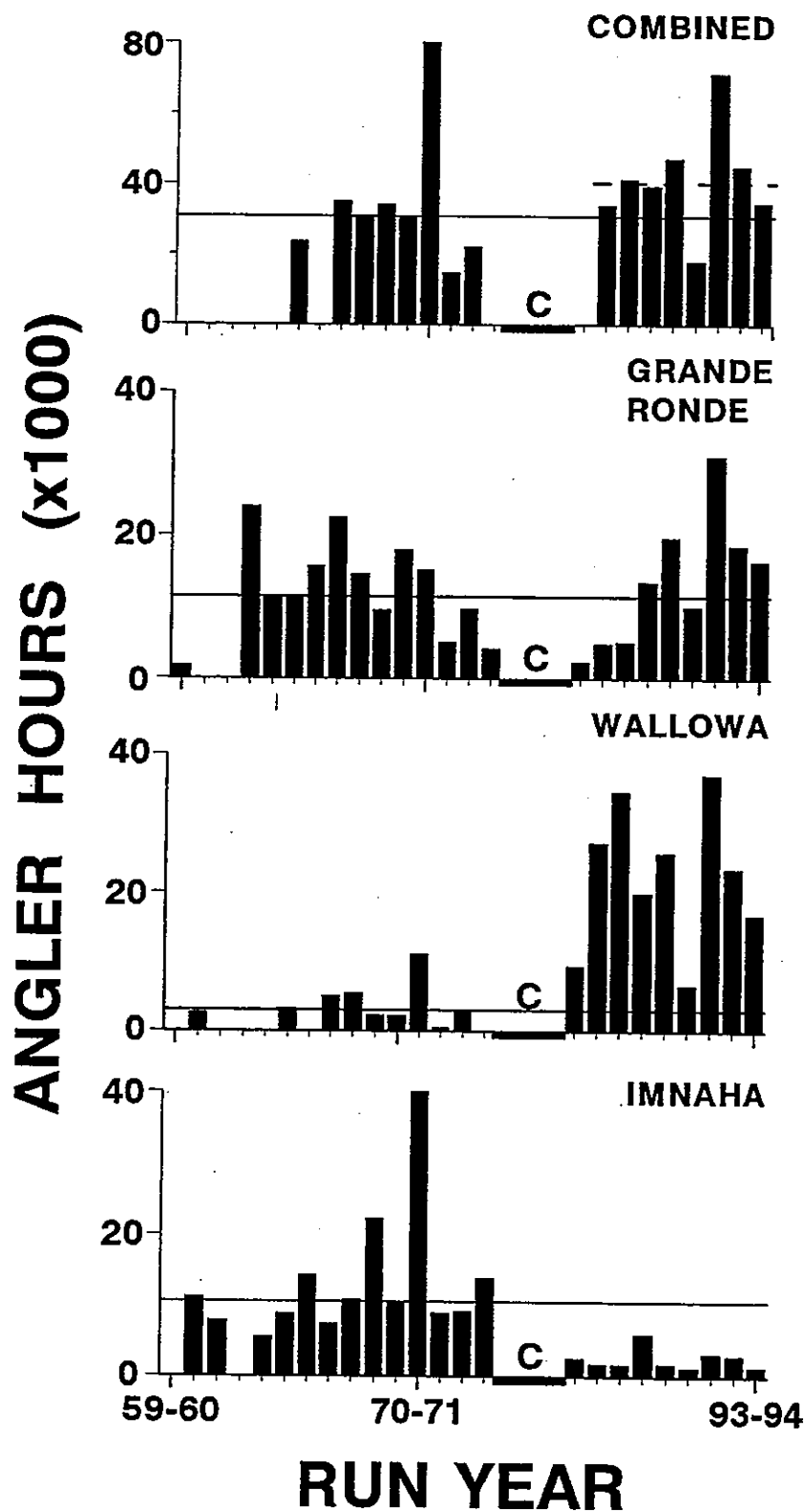


Figure 12. Historic (1960-74) and current (1986-94) angler effort for recreational fisheries on the Grande Ronde, Wallowa, and Imnaha rivers, individually and combined. Solid line = historic median. Dashed line = current median. C = fishery closed. No bars or symbols = data incomplete or unavailable.

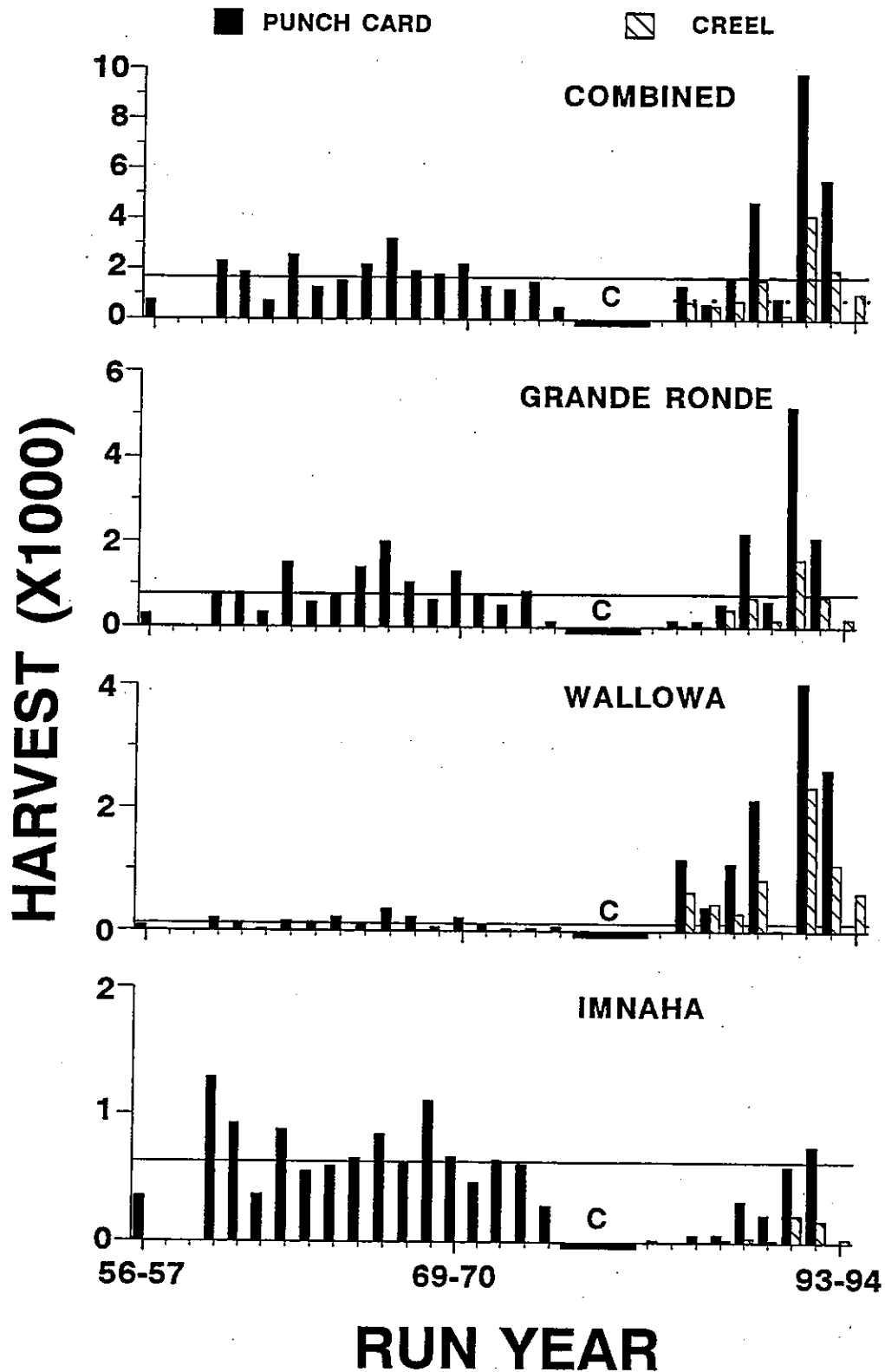


Figure 13. Historic (1957-74) and current (1986-93) punch card harvest, and current (1986-94) creel survey harvest for recreational fisheries on the Grande Ronde, Wallowa, and Imnaha rivers, individually and combined. Solid line = historic median. Dashed line = current punch card median. Dotted line = current creel survey median. C = fishery closed; No bars or symbols = data incomplete or unavailable.

current catch rates (Figure 11), angler effort (Figure 12) or harvest (Figure 13) from combined fisheries. These comparisons indicate that overall recreational summer steelhead fisheries have been restored to historic levels and therefore we have been able to achieve one of the long-term goals (Carmichael 1989) of the Lower Snake River Compensation Plan program in Oregon.

The current fisheries, however, appear to be focused at a different time than they were historically. We compared the distribution of harvest during the fall and spring months from fisheries on the Grande Ronde, Wallowa, and Imnaha rivers combined and found differences between historic and current fisheries. Historically, anglers harvested similar numbers of steelhead during the fall and spring (Figure 14). Currently, the harvest of steelhead during the spring is 4-fold greater than during the fall. If time distribution is an important characteristic in restoring the fisheries, our findings suggest that the time distribution of harvest has not been restored to historic conditions.

The current fisheries also appear to be focused in different areas than they were historically. When comparing the distribution of harvest in fisheries on the Grande Ronde, Wallowa, and Imnaha rivers individually, we found differences between historic and current fisheries. Historically, harvest was highest on the Grande Ronde River and lowest on the Wallowa River (Figure 15). Currently, harvest is highest on the Wallowa River and lowest on

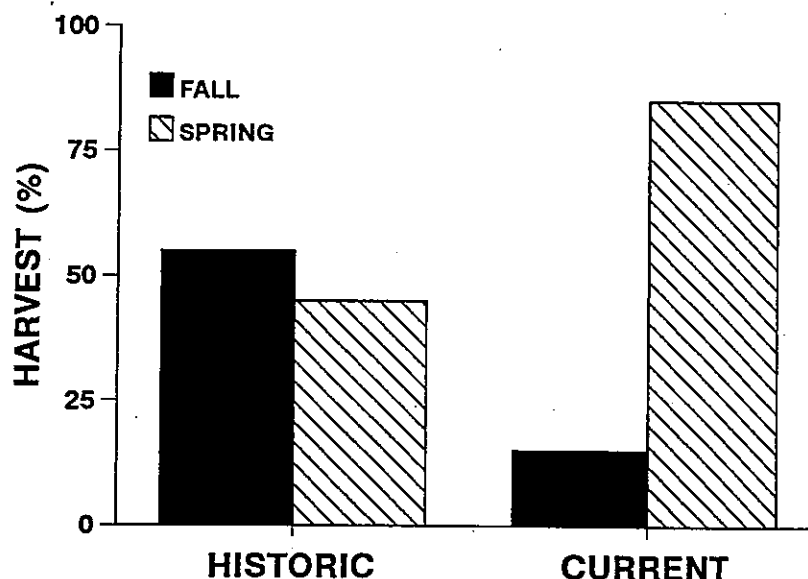


Figure 14. Percent of median historic (1957-74) and current (1987-93) punch card harvest during the fall and spring for summer steelhead recreational fisheries on the Grande Ronde, Wallowa, and Imnaha rivers combined.

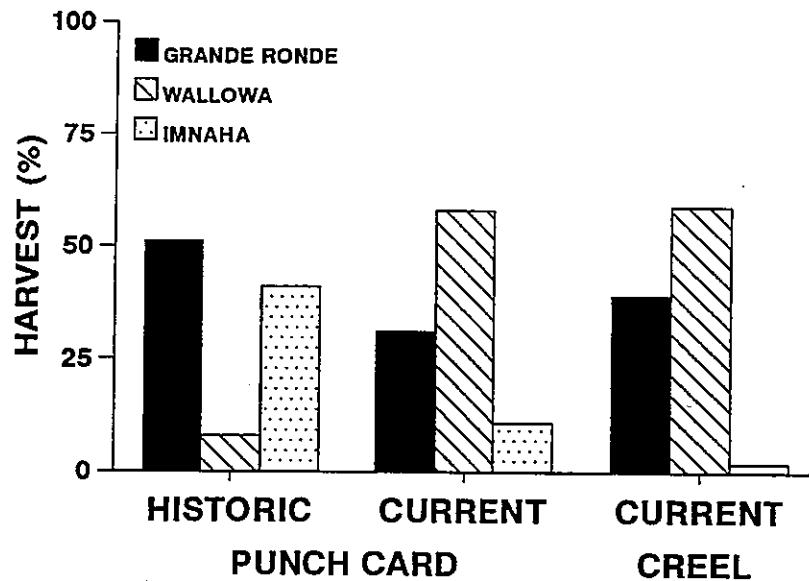


Figure 15. Percent of median historic (1957-74) and current (1987-93) punch card and creel survey (1987-94) harvest for summer steelhead recreational fisheries on the Grande Ronde, Wallowa, and Imnaha rivers.

the Imnaha River. Creel survey estimates also show this same trend of harvest being highest on the Wallowa River and lowest on the Imnaha River.

Current recreational summer steelhead fisheries in the Grande Ronde and Imnaha basins, as a whole, are similar in size to historic fisheries, but do not exhibit similar characteristics to historic fisheries. Whether these fisheries should be or can be reestablished in time and place will be based on future management decisions. Presently, the LSRCF program is providing for substantial recreational summer steelhead fishing opportunities and harvest, similar overall in size to historic fisheries in the Grande Ronde and Imnaha basins.

REFERENCES

- Carmichael, R.W. 1989. Lower Snake River Compensation Plan--Oregon Evaluation Studies, Five-Year Study Plan. Oregon Department of Fish and Wildlife, Fish Research Project, Portland.
- Carmichael, R.W., M.W. Flesher, and R.T. Messmer. 1989. Summer steelhead creel surveys in the Grande Ronde, Wallowa, and Imnaha Rivers for the 1988-89 run year. Oregon Department of Fish and Wildlife, Fish Research Project, Annual Progress Report, Portland.
- Carmichael, R.W., M.W. Flesher, and R.T. Messmer. 1990a. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1989-90 run year. Oregon Department of Fish and Wildlife, Fish Research Project AFFI-91-12, Annual Progress Report, Portland.
- Carmichael, R.W., R.T. Messmer, and B.A. Miller. 1987. Lower Snake River Compensation Plan--Oregon Evaluation Studies. Oregon Department of Fish and Wildlife, Fish Research Project FRI/LSR-88-16, Annual Progress Report, Portland.
- Carmichael, R.W., B.A. Miller, and R.T. Messmer. 1986. Lower Snake River Compensation Plan--Oregon Evaluation Studies. Oregon Department of Fish and Wildlife, Fish Research Project FRI/LSR-86-35, Annual Progress Report, Portland.
- Carmichael, R.W., B.A. Miller, and R.T. Messmer. 1988. Summer steelhead creel surveys in the Grande Ronde, Wallowa, and Imnaha Rivers for the 1987-88 run year. Oregon Department of Fish and Wildlife, Fish Research Project AFFI-LSR-89-02, Annual Progress Report, Portland.
- Carmichael, R.W., and E.J. Wagner. 1983. Evaluation of Lower Snake River Compensation Plan Facilities in Oregon. Oregon Department of Fish and Wildlife, Fish Research Project 14-16-0001-83269, Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and R.T. Messmer. 1991. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1990-91 run year. Oregon Department of Fish and Wildlife, Fish Research Project AFFI-92-09, Annual Progress Report, Portland.
- Flesher, M.W., M.A. Buckman, R.W. Carmichael, R.T. Messmer, and T.A. Whitesel. 1992. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha Rivers for the 1991-92 run year. Oregon Department of Fish and Wildlife, Fish Research Project AFFI-LSR-94-07, Annual Progress Report, Portland.
- Flesher, M.W., M.A. Buckman, R.W. Carmichael, R.T. Messmer, and T.A. Whitesel. 1994. Summer steelhead creel surveys on the Grande Ronde, Wallowa and Imnaha Rivers for the 1992-93 run year. Oregon Department of Fish and Wildlife, Fish Research Project AFFI-LSR-94-14, Annual Progress Report, Portland.

- Jonasson, B.C. and R.B. Lindsay. 1988. Fall Chinook Salmon in the Deschutes River, Oregon. Oregon Department of Fish and Wildlife, Information Reports (Fish) 88-6, Portland.
- Kenaston, K.R. 1989. Estimated Run Size of Winter Steelhead in Oregon Coastal Streams, 1980-85. Oregon Department of Fish and Wildlife, Information Reports (Fish) 89-1, Portland.
- Mendel, G.W., G.A. Lambacher, and M.L. Shuck. 1988. Fall 1986 and Spring 1987 Snake River Steelhead Creel Surveys, Part I: 1986-87 Annual Report, Lyons Ferry Trout Hatchery Evaluation. Washington Department of Wildlife, Fisheries Management Division, 88-7.
- Messmer, R.T., R.W. Carmichael, M.W. Flesher, and T.A. Whitesel. (in preparation). Evaluation of Lower Snake River Compensation Plan Facilities in Oregon. Oregon Department of Fish and Wildlife, Fish Research Project, 1994 Annual Progress Report, Portland.
- Olsen, E.A., R.B. Lindsay and W.A. Burck. 1991. Summer Steelhead in the Deschutes River, Oregon. Oregon Department of Fish and Wildlife, Information Reports (Fish), Portland, (draft Annual Report).
- Oregon Department of Fish and Wildlife. District Annual Reports, LaGrande and Wallawa Districts (1949-1974), Fish Division, Portland.
- Oregon Department of Fish and Wildlife. Salmon and Steelhead Catch Data, (1957-1993), Fish Division, Portland.
- Snedecor, A.W., and W.G. Cochran. 1967. Statistical methods, 6th edition. Iowa State University, Ames, Iowa.
- U.S. Army Corps of Engineers. 1990. Annual Fish Passage Report. Portland and Walla Walla Districts, Portland.
- U.S. Fish and Wildlife Service. 1991. Snake River Hatchery Review 1990 Workshop Summary. Lower Snake River Compensation Plan Office, Boise, Idaho.

Appendix A-1. Fishery statistics for summer steelhead on the lower Grande Ronde River during the 1993-94 run year. Statistics include $\pm 95\%$ confidence interval except for catch rate when expressed as h/fish. Only adipose-marked fish were harvested.

Month, day type	Sample size		Total hours	Total catch	Total harvest	Catch rate fish/h (h/fish)	Angler days
	Days	Anglers					
September:							
Weekday	6	35	724±299	52±71	12±18	0.071±0.098(14)	189±78
Weekend	5	55	765±235	10±11	3±7	0.013±0.014(85)	99±31
Total	11	90	1489±379	62±72	15±20	0.041±0.048(24)	288±73
October:							
Weekday	8	143	2216±554	130±52	16±14	0.059±0.023(17)	323±81
Weekend	6	151	2676±444	80±36	16±22	0.030±0.013(34)	403±67
Total	14	294	4892±710	210±63	32±26	0.043±0.013(23)	726±105
November:							
Weekday	6	45	680±349	31±16	7±9	0.045±0.023(22)	118±61
Weekend	6	88	502±214	28±14	6±6	0.055±0.028(19)	98±42
Total	12	133	1182±410	59±21	13±11	0.049±0.018(20)	216±75
December:							
Weekday	6	23	433±237	15±10	7±11	0.034±0.022(29)	95±52
Weekend	4	35	263±84	5±6	2±4	0.018±0.024(53)	59±19
Total	10	58	696±251	20±11	9±12	0.028±0.016(35)	154±56
February:							
Weekday	6	42	1521±1239	185±167	55±58	0.121±0.106(8)	615±501
Weekend	6	90	1674±566	54±25	33±19	0.032±0.015(31)	283±96
Total	12	132	3195±1362	239±169	88±61	0.075±0.051(13)	898±393
March:							
Weekday	8	36	660±159	104±44	7±13	0.157±0.061(6)	140±34
Weekend	4	38	591±264	35±40	0	0.060±0.067(17)	148±66
Total	12	74	1251±309	139±59	7±13	0.111±0.045(9)	288±71
April:							
Weekday	4	5	55±13	0	0	-- (--)	16±4
Weekend	2	11	123±105	6±9	4	0.049±0.069(21)	21±18
Total	6	16	178±106	6±9	4	0.034±0.048(29)	37±22
Grand total	77	797	12883±1685	735±205	168±72	0.057±0.015(18)	2607±341

Appendix A-2. Fishery statistics for summer steelhead on the upper Grande Ronde River during the 1993-94 run year. Statistics include $\pm 95\%$ confidence interval except for catch rate when expressed as h/fish. Only adipose-marked fish were harvested.

Month, day type	<u>Sample size</u>		Total hours	Total catch	Total harvest	<u>Catch rate</u> fish/h (h/fish)	Angler days
	Days	Anglers					
February:							
Weekday	3	0	0	0	0	-- (--)	0
Weekend	3	6	32 \pm 21	0	0	-- (--)	43 \pm 28
Total	6	6	32 \pm 21	0	0	-- (--)	43 \pm 28
March:							
Weekday	7	75	914 \pm 488	38 \pm 34	5 \pm 9	0.042 \pm 0.037(24)	484 \pm 258
Weekend	4	75	651 \pm 301	15 \pm 23	0	0.023 \pm 0.035(41)	225 \pm 104
Total	11	150	1565 \pm 573	53 \pm 41	5 \pm 9	0.034 \pm 0.026(29)	709 \pm 260
April:							
Weekday	4	108	1243 \pm 335	39 \pm 32	16 \pm 16	0.031 \pm 0.026(32)	299 \pm 81
Weekend	2	46	390 \pm 173	11 \pm 13	5	0.027 \pm 0.034(36)	121 \pm 54
Total	6	154	1633 \pm 377	50 \pm 35	21 \pm 16	0.030 \pm 0.021(33)	420 \pm 97
Grand total	23	310	3230 \pm 687	103 \pm 54	26 \pm 18	0.032 \pm 0.017(31)	1172 \pm 249

Appendix A-3. Fishery statistics for summer steelhead on the lower Wallowa River at Rondowa during the 1993-94 run year. Statistics include $\pm 95\%$ confidence interval except for catch rate when expressed as h/fish. Only adipose-marked fish were harvested.

Month, day type	<u>Sample size</u>		Total hours	Total catch	Total harvest	<u>Catch rate</u> fish/h (h/fish)	Angler days
	Days	Anglers					
March:							
Weekday	4	57	1203 \pm 568	105 \pm 61	72 \pm 50	0.087 \pm 0.041(11)	174 \pm 82
Weekend	2	34	438 \pm 100	50 \pm 36	36 \pm 26	0.114 \pm 0.058(9)	67 \pm 15
Total	6	91	1641 \pm 577	155 \pm 71	108 \pm 57	0.094 \pm 0.034(11)	241 \pm 85
April:							
Weekday	4	29	514 \pm 427	41 \pm 43	19 \pm 21	0.080 \pm 0.067(13)	81 \pm 67
Weekend	2	54	627 \pm 298	32 \pm 54	16 \pm 27	0.051 \pm 0.060(20)	104 \pm 49
Total	6	83	1141 \pm 521	73 \pm 69	35 \pm 34	0.064 \pm 0.045(16)	185 \pm 84
Grand total	12	174	2782 \pm 777	228 \pm 99	143 \pm 66	0.082 \pm 0.027(12)	426 \pm 119

Appendix A-4. Fishery statistics for summer steelhead on the upper Wallowa River during the 1993-94 run year. Statistics include $\pm 95\%$ confidence interval except for catch rate when expressed as hours/fish. Only adipose-marked fish were harvested.

Month, day type	<u>Sample size</u>		Total hours	Total catch	Total harvest	<u>Catch rate</u> fish/h (h/fish)	Angler days
Days	Anglers						
February:							
Weekday	6	19	394 \pm 263	7 \pm 40	0	0.019 \pm 0.101(56)	120 \pm 80
Weekend	5	60	520 \pm 181	9 \pm 5	7 \pm 7	0.017 \pm 0.009(59)	232 \pm 81
Total	11	79	914 \pm 319	16 \pm 40	7 \pm 7	0.018 \pm 0.044(57)	352 \pm 123
March:							
Weekday	7	174	5260 \pm 1647	300 \pm 79	143 \pm 88	0.057 \pm 0.015(18)	1062 \pm 333
Weekend	4	125	3560 \pm 1619	251 \pm 101	155 \pm 73	0.071 \pm 0.028(14)	617 \pm 281
Total	11	299	8820 \pm 2310	551 \pm 128	298 \pm 114	0.062 \pm 0.015(16)	1679 \pm 440
April:							
Weekday	3	90	2433 \pm 113	163 \pm 55	102 \pm 73	0.067 \pm 0.023(15)	549 \pm 25
Weekend	2	64	1977 \pm 200	111 \pm 33	74 \pm 28	0.056 \pm 0.017(18)	239 \pm 24
Total	5	154	4410 \pm 230	274 \pm 64	176 \pm 78	0.062 \pm 0.015(16)	788 \pm 41
Grand total	27	532	14144 \pm 2343	841 \pm 149	481 \pm 138	0.059 \pm 0.011(17)	2819 \pm 467

Appendix A-5. Fishery statistics for summer steelhead on the Imnaha River during the 1993-94 run year. Statistics include $\pm 95\%$ confidence interval except for catch rate when expressed as hours/fish. Only adipose-marked fish were harvested.

Month, day type	<u>Sample size</u>		Total hours	Total catch	Total harvest	<u>Catch rate</u> fish/h (h/fish)	Angler days
Days	Anglers						
March:							
Weekday	8	37	471 \pm 160	29 \pm 20	9 \pm 7	0.061 \pm 0.030(16)	105 \pm 36
Weekend	4	52	445 \pm 236	38 \pm 9	10 \pm 7	0.086 \pm 0.015(12)	106 \pm 56
Total	12	89	916 \pm 285	67 \pm 22	19 \pm 10	0.073 \pm 0.017(14)	211 \pm 66
April:							
Weekday	4	18	220 \pm 78	16 \pm 15	8 \pm 9	0.073 \pm 0.056(14)	43 \pm 15
Weekend	2	27	200 \pm 24	18 \pm 17	2 \pm 2	0.090 \pm 0.060(11)	44 \pm 5
Total	6	45	420 \pm 82	34 \pm 23	10 \pm 9	0.081 \pm 0.041(12)	87 \pm 17
Grand total	18	134	1336 \pm 296	101 \pm 32	29 \pm 13	0.076 \pm 0.017(13)	298 \pm 66

Appendix B. Percent of the summer steelhead caught in the Grande Ronde and Imnaha basins during the 1993-94 run year that were hatchery fish. Sample size is shown in parentheses.

Creel survey area	Sep	Oct	Nov	Dec	Feb	Mar	Apr
Lower Grande Ronde	27(62)	26(210)	31(59)	45(20)	56(239)	11(139)	67(6)
Upper Grande Ronde	--	--	--	--	--	17(53)	70(50)
Lower Wallowa at Rondwa	--	--	--	--	--	88(155)	62(73)
Upper Wallowa	--	--	--	--	56(16)	65(551)	69(274)
Imnaha	--	--	--	--	--	28(67)	29(34)



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